

## Multi-specialty knowledge on surgical airway management: Implementation of an educational initiative<sup>☆</sup>

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### ABSTRACT

**Purpose:** Deficiencies in airway management knowledge can result in harm, especially in tracheostomy patients. Our objective is to assess the degree of knowledge in different medical specialties, before and after targeted airway education.

**Materials and methods:** A lecture on tracheostomy management was prepared for Otolaryngology, Anesthesia, Emergency Medicine, General Surgery, Oral and Maxillofacial Surgery (OMFS), Internal Medicine (IM), and Family Medicine (FM). Before the lecture, a 12-question quiz on surgical airway knowledge was administered, and demographics from participants collected. Immediately following the lecture, participants were asked to retake the quiz. Performance was assessed. Population baseline characteristics included, specialty, years of practice, and previous education.

**Results:** A paired *t*-test evaluating pre- and post-lecture results showed a 34.2% improvement for all participants ( $n = 168$ ) overall (2.7 points,  $p < 0.001$ ). Providers with more years of practice performed better. Otolaryngology and OMFS performed the highest on the baseline test while FM and IM performed the lowest. The providers who reported previous standardized training from the hospital system, informal instruction on the ward, or had the topic covered in their degree program performed better compared to those without previous education (ANOVA, 3.5 points,  $p < 0.01$ ). Providers who underwent formal training in their degree program performed the best. A Likert scale with self-assessment of comfort with surgical airway correlated positively with the performance on the quiz.

**Conclusion:** Variability in tracheostomy knowledge based on specialty and years of training exists. We demonstrate that formal education on tracheostomy and surgical airways improved quantitative measures of knowledge.

### 1. Introduction

Airway management is a critical aspect of patient care that is pertinent to all medical specialties. Surgical airway patients such as those with tracheostomies, stomas, or other airway stents and appliances can be among the most difficult patients to manage. Many practitioners have limited or no exposure to these patients during training [1]. We have witnessed multiple morbidities and mortalities within our hospital system due to inappropriate management of these patients. Overall, the field of Otolaryngology, Anesthesia, and Oral and Maxillofacial Surgery are historically known for their expertise in airway and surgical airway management. In addition, various specialties including but not limited to General Surgery, Emergency Medicine, and Internal Medicine are

also required to gain airway management expertise.

There is immense variability in training and knowledge on airway related topics among various specialties. Most training programs are based on an apprenticeship model where exposure is dependent on the interest of the supervising provider and the patients that happen to come under his or her care [2]. In fields such as Anesthesiology, it is generally understood that airway management cannot be solely taught based on patient exposure. Therefore, it is important to receive additional training on airway management beyond clinical experience. Education can be presented in various forms including simulation based training and non-simulation based forms including lectures, videos, discussion, and observation. Studies on airway management education have shown that non-simulation based training and simulation based

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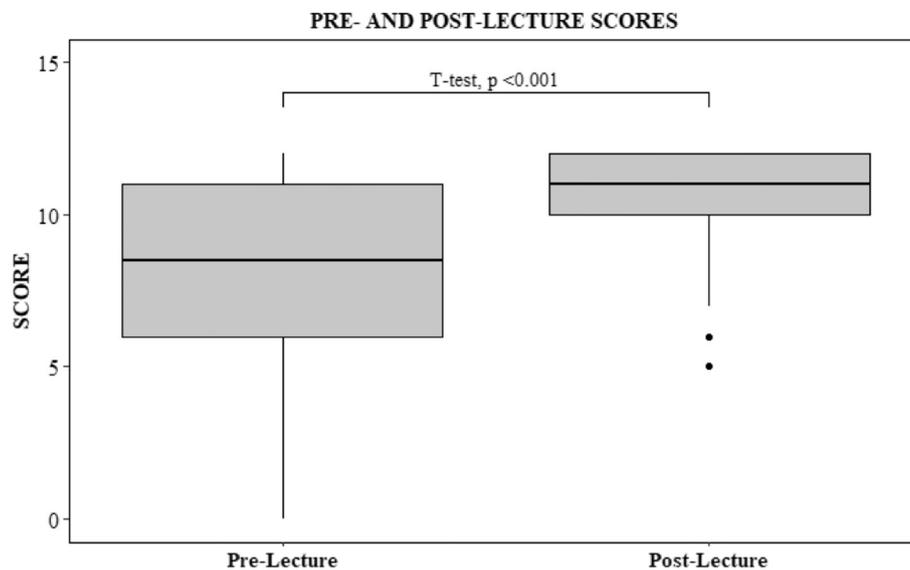


Fig. 1. A paired *t*-test evaluating overall pre- and post-lecture performance in the 12-question quiz showed a 34.2% improvement for all participants ( $n = 168$ ) overall with a mean difference of 2.7 points ( $p < 0.001$ ).

training can be equally effective [3].

Deficiencies in airway management training can result in serious life-threatening adverse events. With this in mind, the Otolaryngology department designed a standardized educational lecture on airway management, which was then delivered to providers across various specialties. We assessed the degree of knowledge before and after targeted airway education using a 12-question quiz. Our ultimate goal was to organize a sustainable airway education program to improve and standardize airway knowledge among hospital providers.

## 2. Materials and methods

Our institution is a large tertiary care academic medical center with 1032 beds. All medical specialties are represented at our institution with their respective residency programs. The educational initiative took place from July to September of 2017. We scheduled our initiative to start at the beginning of the academic year as new residents start their training in July. This initiative was presented and approved by our medical system's Institutional Review Board (IRB).

A lecture on tracheostomy and surgical airway management was prepared by residents and faculty of the Otolaryngology department. This lecture consisted of 45 min of content covering the basics of tracheostomies, stomas, and other surgical airways. Initial focus was placed on identifying the parts and function of a tracheostomy tube. In addition, we covered variations in tracheostomies including brand, size, cuffed or uncuffed, inner cannulas, fenestration, speaking valves and capping. Explanation on stomas and total laryngectomy patient care was also covered. At the end of the presentation, we reviewed management of common tracheostomy related emergencies.

A 12-question quiz was created by residents and faculty of the Otolaryngology department. The quiz contained questions on identifying the parts of a tracheostomy tube as well as basic questions on airway management. The questions were designed with the standard that an average Otolaryngology intern level resident should be able to accurately answer all of them. The quiz also collected information on specialty, years of practice, previous airway education, personal exposure to airway emergencies, and self-assessment of comfort with tracheostomy and surgical airway management.

The lecture was given at the grand rounds for Otolaryngology, Anesthesia, Emergency Medicine, General Surgery, Oral and Maxillofacial Surgery (OMFS), Internal Medicine (IM), and Family Medicine (FM). The audience consisted of residents, fellows, and

attending physicians. Before the lecture, the 12-question quiz on surgical airway knowledge was administered, and demographics from participants were collected on each quiz. Immediately following the lecture, participants were asked to retake the quiz. Pre- and post-lecture performance was compared. Baseline knowledge was assessed using variables including specialty, years of practice, and previous airway education.

### 2.1. Statistical analysis

The outcome measure used was the score obtained on the 12-question quiz. Two quizzes were performed, one before and one after the airway education seminar. A self-assessment of comfort with airway management using a Likert scale was included and then correlated with the results. For the outcome measure analysis a paired *t*-test was performed to compare pre- and post-lecture groups, unpaired *t*-test were used for comparisons between independent groups, and Tukey's HSD ANOVA was used for comparisons between three or more groups. The Likert self-assessment score was correlated with the results using a Spearman correlation. Significance was considered at  $\alpha < 0.05$ . The analysis was made on R Statistical Software (Version 3.5.1).

## 3. Results

A total of 168 participants were used in our data analysis. The lecture was given to over 300 providers, but a significant portion were excluded from the study due to lack of completion of the pre and/or post lecture quiz as well as not being present for the entirety of the airway education lecture. A paired *t*-test evaluating overall pre- and post-lecture results of questions 1 to 12 showed a 34.2% improvement for all participants ( $n = 168$ ) overall with a mean difference of 2.7 points (95% CI 2.27–3.09,  $p < 0.001$ ). Mean pre-lecture score was 7.9 points (SD = 3.08) compared to 10.6 points (SD = 1.47) (95% CI 2.27–3.09,  $p < 0.001$ ) (Fig. 1). Otolaryngology and OMFS performed the highest on the baseline test while FM and IM performed the lowest (Fig. 2, Table 1). Providers with more years of practice performed better with a mean difference of 3.7 points (95% CI 2.76–4.49,  $p < 0.001$ ). Providers were divided into junior ( $n = 90$ ) and senior ( $n = 78$ ) level. Juniors were defined as having 1 or 2 years of training in their respective fields, while senior level providers had 3 or more years. Mean pre-lecture score was 6.38 points (SD = 2.99) in junior compared to 9.69 points (SD = 2.09) in senior level providers (95% CI 2.54–4.09,

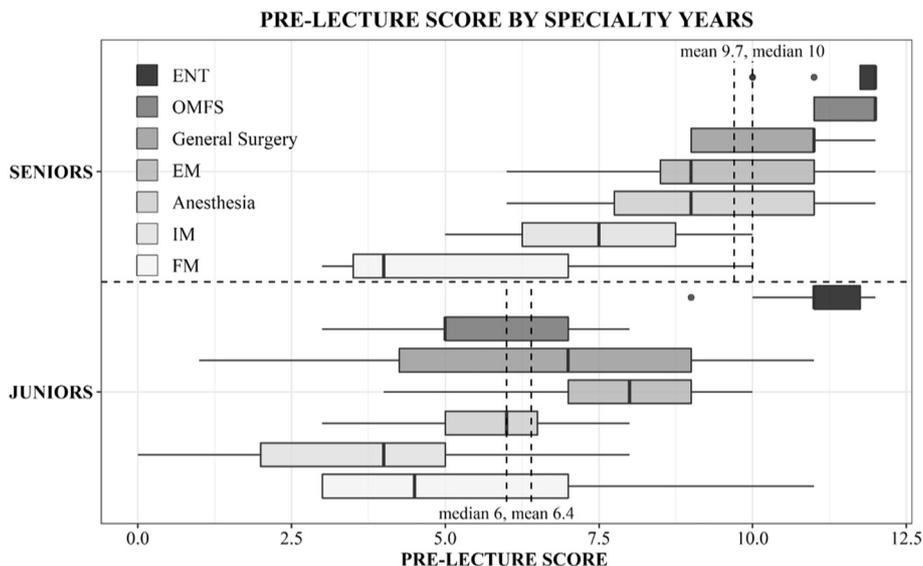


Fig. 2. Performance on the airway questionnaire divided amongst specialty and years of experience (juniors vs seniors).

p < 0.001).

The physicians who reported previous standardized surgical airway management training from the hospital system, informal instruction on the ward, or had the topic covered in their degree program performed better (mean = 9.4 points) compared to those without previous education (mean = 5.9 points) (95% CI 2.74-4.31, p < 0.001) (Table 2). Overall, providers who received training only during their degree program or training during their degree program combined with any other type of training, performed the best (mean = 10.22 points), when compared with providers who received training but not as part of their degree program (mean = 8.8 points) (95% CI 0.44-2.32, p < 0.001).

A Likert scale of self-assessment on comfort with surgical airway management had a positive correlation (r<sub>s</sub> = 0.6, p < 0.001) with performance on the baseline quiz. Providers with a self-assessment score from 1 to 3 (n = 62) had a mean score of 6.0 points, with self-assessment 4–7 (n = 78) the mean score was 8.5 points and with self-assessment 8–10 (n = 28) the mean score was 10.5 points (Fig. 3).

4. Discussion

Unfortunately, deficiencies in knowledge of airway management can lead to patient morbidity and mortality, especially in patients with surgical airways [4–6]. The main goal of our Otolaryngology quality improvement initiative was to assess baseline knowledge and then educate providers of various specialties on surgical airway management to prevent these complications. Similar efforts on airway education have been developed and demonstrated to improve clinical knowledge, technical skill, and self-perceived comfort in airway management [7–10]. However, there is minimal research specifically looking at tracheostomy, stoma, and surgical airway patients.

We began by attempting to identify the most effective and sustainable mode of presentation for our educational program. Simulation-

Table 2

A two sample t-test evaluating pre- and post-lecture questions results of providers who had no previous airway training vs individuals who had undergone standardized surgical airway management training from the hospital system, informal instruction on the ward, or had the topic covered in their degree program.

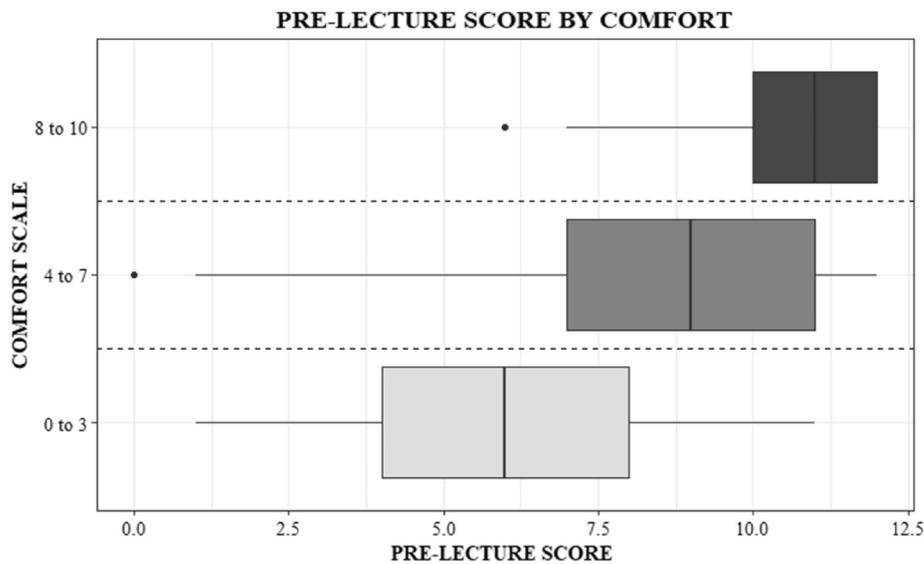
n	No training	Any type of training	t-test
	72	96	
Pre-lecture Mean (SD)	5.90 (2.55)	9.43 (2.55)	p < 0.001 95% CI (2.74, 4.31)
Post-lecture Mean (SD)	10.10 (1.59)	10.97 (1.26)	p < 0.001 95% CI (0.42, 1.32)

based training has been utilized and found to be effective in airway education [11–13], but studies have also shown that non-simulation based training such as lectures, videos, and discussion can be equally effective [3]. We chose to present the information in a one-session lecture-based format due to ease of delivery, ability to include the largest number of participants, and sustainability of the program. A total of 168 residents, fellows, and attending physicians were included in our analysis.

A 12-question quiz was used to assess baseline knowledge and improvement in airway management understanding following the lecture. The questions were created with the target that an average Otolaryngology intern level resident should be able to accurately answer all questions correctly. When baseline performance was broken down among specialty, we found that Otolaryngology and OMFS performed the highest on the baseline test while FM and IM performed the lowest. General Surgery and EM's performance was midway between the above-mentioned specialties. These results are consistent with the level of exposure that each specialty have to tracheostomies, stomas,

Table 1 Performance on the airway questionnaire divided amongst specialty.

Score	Family medicine	Internal medicine	Anesthesia	Emergency medicine	General surgery	Oral and maxillofacial surgery	Otolaryngology
n	15	23	35	28	35	10	22
Pre-lecture Mean (SD)	5.40 (2.64)	4.22 (2.33)	8.40 (2.24)	8.57 (1.97)	8.09 (2.88)	8.60 (3.44)	11.32 (0.89)
Post-lecture Mean (SD)	10.00 (1.60)	10.13 (1.60)	10.20 (1.39)	10.61 (1.34)	10.60 (1.52)	11.20 (1.32)	11.82 (0.66)



**Fig. 3.** A Likert scale of self-assessment on comfort with surgical airway management had a positive correlation with performance on the baseline quiz. Providers with a self-assessment score from 1–3 ( $n = 62$ ) had a mean score of 6.0 points, with self-assessment 4–7 ( $n = 78$ ) the mean score was 8.5 points and with self-assessment 8–10 ( $n = 28$ ) the mean score was 10.5 points.

and surgical airways. Also, as would be expected, there was a significant improvement in performance when comparing years of experience by dividing senior and junior level providers.

We analyzed previous training that each provider may have received on surgical airway management. We found that participants who received standardized surgical airway management training from the hospital system, informal instruction on the ward, or had the topic covered in their degree program performed significantly better compared to those without previous education. Overall, providers who underwent training in their degree program performed the best. This highlights the importance of a standardized educational program incorporated into training programs.

Finally, as part of the questionnaire, we utilized a Likert scale to quantify each participant's self-perceived comfort and knowledge on surgical airways. Interestingly, this Likert scale of self-assessment had a significant positive correlation with performance on the baseline quiz. This supports that providers have an accurate perception of their knowledge, which is reflected in their performance on our assessment.

Airway management training is critical in all specialties and mastery or, at least, competency is necessary to avoid life-threatening events for patients. To gain that mastery, hospitals need to create targeted airway education programs, to enhance the apprenticeship model of training. Also, there is research showing that training among hospital staff should be standardized to avoid different terminology and different mind-sets when managing difficult airways [2,14]. Training in airway needs to be prioritized in every hospital to decrease hospital morbidity and mortality in the vulnerable population of surgical airway patients.

## 5. Conclusion

It is challenging for healthcare providers to become educated on surgical airways solely on their own experience without any formal training. Standardized education is important to increase provider's confidence and competence in surgical airway management. We found that there is significant variability in tracheostomy and surgical airway

knowledge based on specialty and years of training. We demonstrate that formal education on tracheostomy and surgical airways improved quantitative measures of knowledge. We hope that this will ultimately lead to reduction in adverse events in surgical airway patients.

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